NCI Evaluation Guidelines for Phase II eHealth SBIR/STTR Grantees and Contractors

October 2007

RATIONALE:

Why were these evaluation guidelines developed?
Conducting user-centered design evaluations is a requirement for eHealth SBIR/STTR Grantees and Contractors. The evaluations will help ensure your product works for its intended users; the process will also enhance the marketability of your finished product. This document explains how to fulfill your requirements.

Who conducts the evaluations?
Evaluations must be conducted by independent contractors you hire, with the approval of NCI's User-Center Informatics Research Lab (UCIRL). The required fee is not paid to NCI.

Does this evaluation replace the required usability testing conducted by the grantee?
No, you must conduct your own usability testing on the content and delivery approaches used in your product. The NCI evaluations will focus more intensely on the format and on information flow and delivery.

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Evaluation Requirements Checklist

Requirement summary for Phase II: Conduct two NCI-approved user-centered design (UCD) evaluations.

Reason for this requirement: To improve the proposed product's usability before final development and formal impact studies. To increase the product's efficacy and success rate.

Check list	Steps or tasks
	Set aside $30,000 total for the evaluations in your application.
	Planning Evaluation 1:
	☑ Contact NCI's UCIRL consultant, copying your NCI Program Director by email, to begin planning the evaluation.
	☑ Email the Request for an Evaluation (Appendix VII) to the UCIRL, again copying your NCI Program Director
	☑ Discuss the evaluation research needs with the UCIRL consultant.
	☑ Contract with a professional UCD facilitator.
	☑ Email a Statement of Goals for Evaluation 1 to your NCI Program Director and copy the UCIRL consultant.
	Conducting Evaluation 1:
	☑ Have your facilitator conduct the evaluation, give you a written report of findings and recommendations, and advise you on recommended changes.
	☑ Review the evaluation report findings.
	☑ Adjust the product design based on the usability issues found.
	☑ Submit 1) a copy of Evaluation Report 1 and 2) a document citing how you corrected the issues to both your NCI Program Director and the UCIRL consultant.
	Planning Evaluation 2:
	☑ Email the Request for an Evaluation (Appendix VII) to the UCIRL and copy your NCI Program Director.
	☑ Discuss the evaluation research needs with the UCIRL consultant.
	☑ Contract with a professional UCD facilitator.
	☑ Submit the Statement of Goals for required evaluation 2 to your NCI Program Director and copy the UCIRL consultant.
	☑ Contact the UCIRL to reserve the facilities for Evaluation 2 at NCI.
	Conducting Evaluation 2:
	☑ Have the facilitator conduct the evaluation, give you a written report of findings and recommendations, and advise you on recommended changes. (If you plan to attend the evaluation sessions at NCI, please let the UCIRL know your needs.)
	☑ Review the evaluation report findings.
	☑ Adjust the product design based on the usability issues found.
	☑ Submit 1) a copy of Evaluation Report 2 and 2) a document citing how you corrected the issues to both your NCI Program Director and the UCIRL consultant.
	☑ If your product's usability goals were not met during Evaluation 2, contact your NCI Program Director to discuss how to proceed.

I. SBIR Evaluation Requirements

The Division of Cancer Control and Population Sciences (DCCPS) at the National Cancer Institute (NCI) requires its eHealth Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grantees and contractors to conduct two user-centered evaluations as part of ensuring a usable—as well as useful—product[1] .

Experienced professionals typically follow a *user-centered design process (UCD)* to build the components of good usability—and therefore greater likelihood of success—into their products. Following the process means closely considering and interacting with your product's end-users or audience *before, during, and after* designing the product.

NCI hopes to prevent design issues from interfering with the success of SBIR grant and contract products. Conducting the evaluations will let you avoid many of these design issues.

This document:

- lays out the requirements for the required product evaluations
- gives guidance for how and when to perform such evaluations in your development process
- explains how to request help from NCI in finding a professional evaluation facilitator and in using NCI's cost-saving evaluation lab
- provides background information about user-centered design (UCD) and how it can improve products

Some grantees and contractors have experience in planning UCD research, but many do not. To learn more about UCD methods and usability-focused activities, review the Key Knowledge reference sections. You can also contact the UCIRL for more detail.

Note: Your comments will help us improve this document for future use. (Send your comments to the general contact email for the UCIRL, 61164thflrlab@mail.nih.gov .)

Meeting Your Requirements as a Grantee or a Contractor

NCI's evaluation requirements focus on your conducting UCD evaluations before and/or during the design process. While there are many UCD methods, and NCI urges you to apply them to your benefit, SBIR Phase II grantees and contractors must conduct **at least two** user-centered evaluations on their product in Phase II.

See the chart on the next page for the basic requirements. Also see the checklist at the beginning of this document.

[1] *Throughout, when we refer to "products," we include all types of products: documents, hand-held devices, websites, software, games, CDs, and other media. The basic requirements and methods will be the same for all products.*

Evaluation Requirements for Phase II Grantees and Contractors

Requirements:

- Conduct two evaluations during Phase II:
  - Evaluation 1, a design-oriented evaluation
  - Evaluation 2, either a design- or a metrics-oriented evaluation
- Modify your product to address the findings after each evaluation (design, test; redesign, test)
- Document the evaluation goals, findings, and changes for your NCI Program Director and NCI's User-Centered Informatics Research Lab (UCIRL) Consultant

Additionally:

- Evaluation 2 must be planned, conducted, and analyzed by an independent, professional facilitator. This facilitator must be identified or approved by NCI's UCIRL. (The same facilitator may also conduct Evaluation 1.)*
- Evaluation 2 must be conducted in NCI's UCIRL facility.

Deliverables:

- Your statement of usability goals for Evaluation 1**
- The facilitator's Evaluation Report of Findings and Recommendations for Evaluation 1
- Your document of changes made to address issues found in Evaluation 1
- Your Statement of usability goals for Evaluation 2
- The facilitator's Evaluation Report of Findings and Recommendations for Evaluation 2
- Your document of changes made to address issues found in Evaluation 2. For Round 2, discuss how your redesign did or did not meet the usability goals that you set out to test.

**See "Using NCI's User-Centered Design Resources" in Section II.*

*** Details on how to set goals and how and when to test are provided in later sections. We will work with you to help you determine the best way to set and meet appropriate evaluation goals.*

The first evaluation must be *design-oriented*—it is intended to help you assess and improve your product design before you invest time and money fully developing it. Evaluation 1 will provide early data on *why* usability problems are occurring. (NCI's UCIRL can help you find a professional consultant to advise you and conduct the evaluations. See the UCIRL contact information later in the document.)

The second evaluation is intended to assess whether the resulting redesign solved the issues and to see whether the product's level of usability is acceptable. Evaluation 2 can be either design-oriented or metrics-oriented. (*Metrics-oriented* means assessing the product's usability against established goals for criteria such as completion rate, completion time, and

number of errors. Goals must be valid and reasonable.) Establishing and measuring the metrics can tell you whether your product has the desired level of usability. Evaluation 2 must be conducted at NCI's UCIRL by an independent facilitator identified or approved by NCI, whether the evaluation is a design- or a metrics-oriented evaluation.

What to Do if You Do Not Meet the Requirements

Sometimes the first redesign does not solve enough of the major design concerns, or the redesign solution reveals new issues to address. If this happens in your case, you must make further efforts to meet the requirements. Seek guidance from your NCI Program Director to determine the most appropriate next steps.

II. Planning for the Required Evaluations in Your Grant

Now that you know the evaluation requirements, consider what you want evaluated based on the product's characteristics and your audience's needs. If you are not familiar with user-centered design methods, see reference sections III and IV for more detail.

You should:

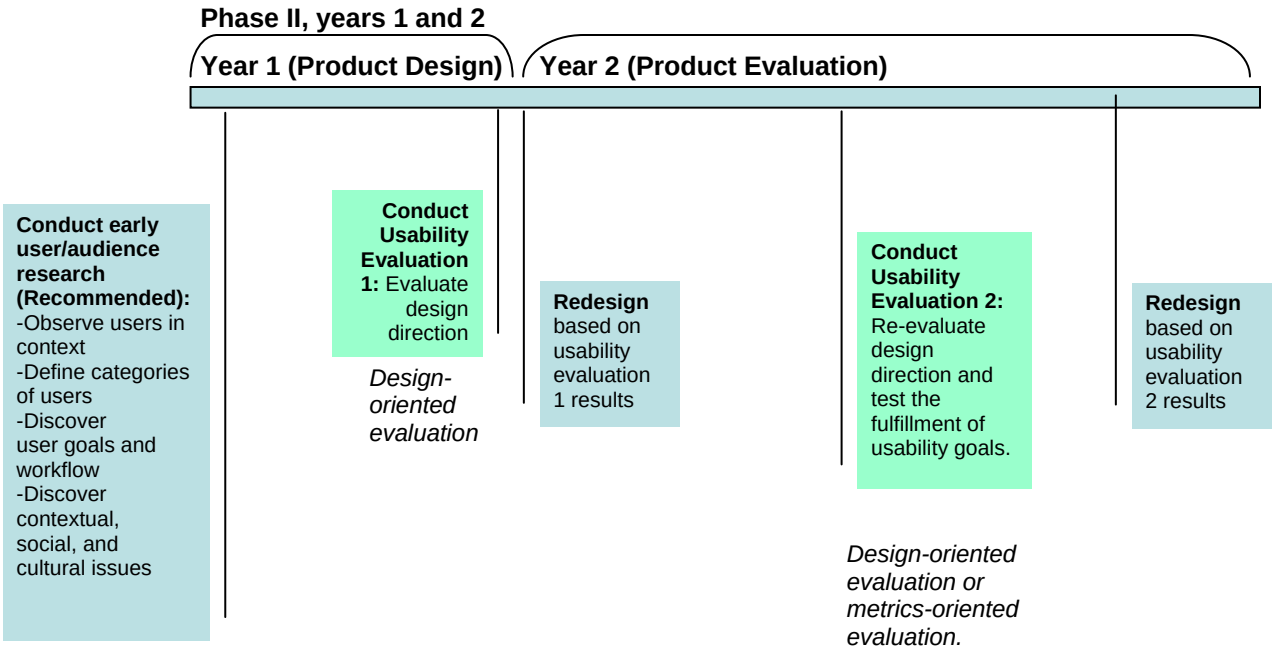
- Consider where you are in the grant process and what type of product you have
- Contact the UCIRL at the beginning of Phase II to begin planning for Evaluation 1
- Identify and contract with a professional facilitator who will plan and conduct the evaluations
- Fix the issues found, and consider when to conduct the second evaluation
- Repeat

Timing the Evaluations Within the Grant Process

Some grantees receive their grants to develop a *new product* from the beginning. With new products, you can have your design evaluated before you finish building an expensive, functioning prototype. Other grantees receive grants to evaluate or continue development of an *existing product* they have already created. Regardless, you will do the required evaluations in Phase II, after your initial development research. Both new products and existing products require two rounds of evaluation.

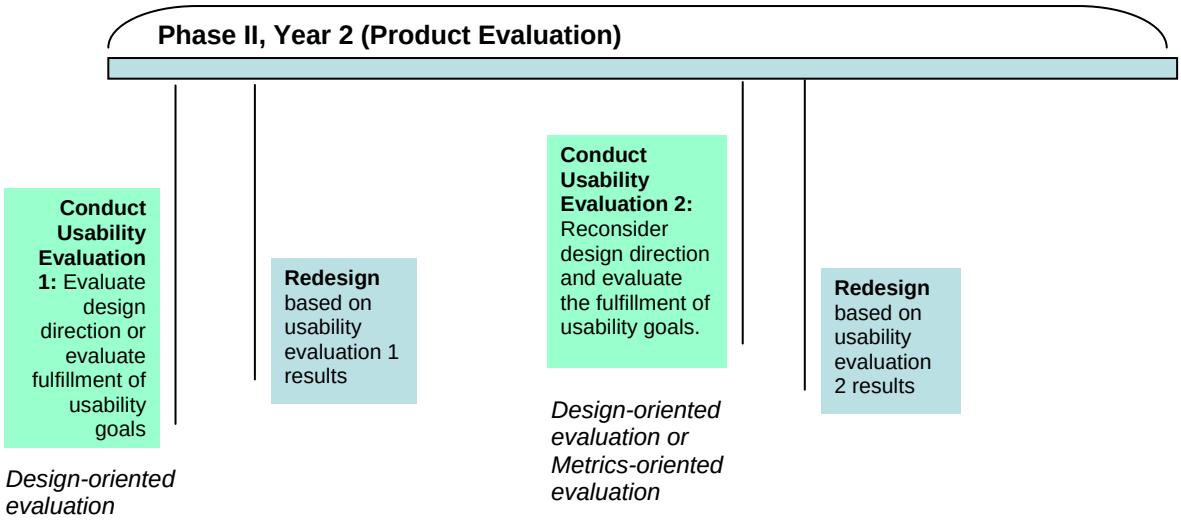
New Products. If you are evaluating a new product, you should evaluate first on the product design sketches or prototypes (a.k.a., "comps," "mockups," "wireframes," "storyboards," etc.). Your first evaluation should be done before you begin building the product prototype, if possible, because a design-oriented evaluation will help set design direction. (See Section IV under "Types of Evaluations" for more information.)

Usability Evaluation Timeline for New Products



Existing Products. If you are evaluating an existing product, you will begin evaluation on your current product or prototype. Your first evaluation should be a design-oriented evaluation because it provides more information on why the design is failing (or working), as well as where and how.

Usability Evaluation Timeline for Existing Products



Using NCI's User-Centered Design Resources: The UCIRL

The *User-Centered Informatics Research Lab (UCIRL)* performs UCD research to improve the usability of NCI's Bio-, Health, and Medical Informatics interfaces and products of all types. The UCIRL also works with NCI's eHealth SBIR Program Director to help grantees and contractors meet their user-centered evaluation requirements.

The staff at NCI's UCIRL can:

- advise grantees and contractors about how and when to evaluate their product
- identify and/or approve independent facilitators for you to use
- can provide free access to the UCIRL's evaluation facility in Rockville, MD (located near Washington, DC)

UCIRL staff do not conduct the evaluations; you must include the cost of an independent facilitator in your application to conduct and analyze the evaluations (currently $30,000 total).

Skills, Knowledge, and Services available. The UCIRL employs a knowledgeable User-Centered Informatics Research consultant who can help you determine the best evaluation strategy. The consultant can also provide a more detailed project plan for the evaluation and schedule evaluations in the facility. Grantees and contractors can speak directly with the UCIRL's user-centered informatics design consultant at no charge.

The consultant maintains a list of professional UCD experts, including usability evaluation facilitators, and can help match you with these consultants and provide their contact information. The consultant can also provide expert advice and guidance on how and when to evaluate, what is needed for evaluation, and how to handle usability issues that arise.

Remember to fill out the Request for an Evaluation in Appendix A before contacting the UCIRL to discuss the evaluations.

To contact the UCIRL Consultant, currently Christy Mylks:

- (301) 451-9969
- mylksc@mail.nih.gov

Allow for response time.

The NCI UCIRL Facility: Free to You. NCI's UCIRL facility includes a research lab with an evaluation room and separate observation room. As an NCI grantee or contractor, you may use this facility *at no cost* to you.

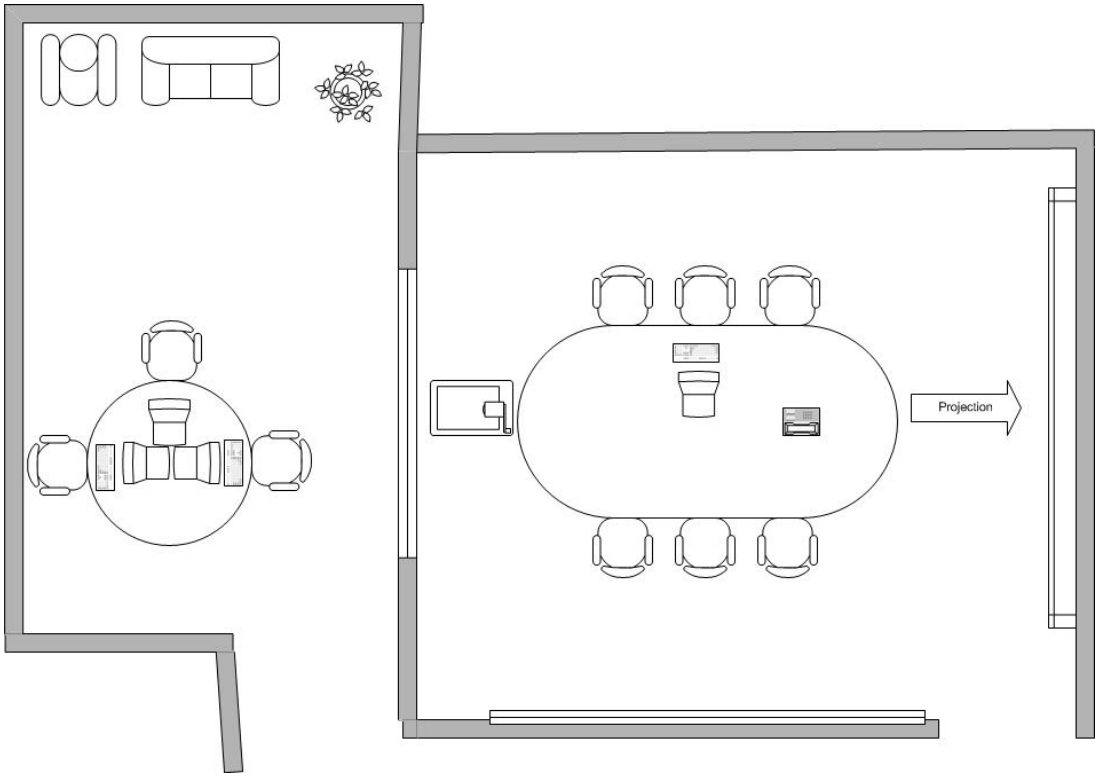
The facility includes the following resources:

- Dedicated, in-lab technical and AV support
- Comfortable rooms appropriate for usability evaluation, card-sorting, interviews, etc.
- Unobtrusive cameras and microphones
- Computers and Internet access for both Windows and Mac operating systems
- Table space for card sorting, laying out materials, evaluating physical devices
- Audio and videotaping to DVD, DV (digital video tape), and VHS or to CD-ROM
- Projection equipment showing evaluation participants' computer screen and gestures or facial expressions simultaneously (by picture-in-picture projection)
- Screen-capture software for capturing a video of what users see and do on-screen at the computer (for web and software products)

Related lab capabilities:

- Your facilitator can conduct "remote evaluation" from the UCIRL with participants in different geographical locations (using software and equipment in the Lab)
- For most evaluations, allows members of your team to observe by remote connection
- Tools for accessibility evaluation (a.k.a. Section 508 compliance to allow people who are visually impaired to access websites)

SBIR grantees and contractors *must conduct at least one evaluation at the UCIRL* but are not required to use the UCIRL facility for both evaluations. (If you need to be exempted from this requirement, please discuss this with the UCIRL Consultant.) However, because the facility is available to you for free, the cost for a facility was not included in the evaluation cost estimates. Usability evaluation experts sometimes have their own labs, and you can also conduct less formal usability evaluations in conference rooms or other available spaces.



The UCIRL facility in Rockville, MD. The Design, evaluation, and interview room (left) provides remote viewing options, screen-capture software, product-evaluation videotaping, and viewing via one-way mirror from the Observation Room (right). The Observation room has the capability to project activities from the Design room or to remote viewers, as well as space to host larger focus groups and other activities.

Mobile evaluation can be done with a laptop and portable camera.

Mobile Usability Evaluation. As an alternative, some facilitators run evaluations at users' own locations. Evaluation in-context at the location where the person will likely use the product can add valuable information about how effective the product is within the genuine usage environment.

Understanding the environment or "context" of use is an important part of the UCD process in any case, because you may discover challenges to the design that would not appear in a lab: distractions, loud noises, social or peer pressures, space limitations, cultural disparities, and more.

The UCIRL has a mobile usability evaluation laptop and camera setup for conducting and taping computer-based evaluations at users' locations (their worksites, homes, schools, conferences). The laptop includes specialized software (TechSmith "Morae") for recording audio, video, and/or screen activities; marking observer comments and logging times; and combining all results into a single movie file for analysis and presentation.

A UCIRL staff member or approved facilitator under contract must accompany the Mobile Lab if you wish to use this equipment. (These travel costs can be added and incorporated into your evaluation budget, but have not been included in the estimate.)

Contracting with a Facilitator and Budgeting the Evaluation

Once you have contacted the UCIRL, you will need to find and set up a contract with a professional UCD facilitator to help you plan and conduct the evaluations. Even though the UCIRL consultant might put you in touch with a facilitator, the contract will be between you and the facilitator.

Tips for Contracting with a Facilitator

There are several ways to find a facilitator:

- If you already know or use a facilitator, send this person's contact information to the UCIRL consultant for approval.
- If you need help finding a facilitator, ask for recommendations, look online for consultants in your area (see the Resources appendix), or ask the UCIRL consultant for advice.

A few skills to look for include:

- More than 5 years of solid experience planning and facilitating Usability Tests and other user research and UCD methods, not just product design or development
- Possibly, experience with the product domain (e.g., cellphone interfaces, documents, TV)
- Possibly, a degree in HCI, Human Factors, Cognitive Psychology, or Human Factors

Buzzwords and job titles to look for in a facilitator's background include:

- Usability engineer
- UCD consultant
- Human Factors Engineer
- HCI (Human Computer Interaction)
- User Experience (for Internet and related new technologies, if a strong user research background is present)
- Interaction Designer (if they have a strong user research background rather than just a web design background)

Companies to look for:

- Usability Engineering companies and consultancies
- UCD companies and consultancies
- User Experience consultancies (for the Internet; must have a strong research bent)
- Sometimes, Market Research companies offer usability testing, but few MR companies have experienced usability facilitators in-house (they may use focus group facilitators or interviewers, and this is a different skill). This means the markup costs will be passed on to you if they hire someone outside their firm.

Expected Costs for the Evaluations

On the next page is the breakdown of typical costs for contracting with a professional facilitator to conduct the usability evaluations. These numbers were used to estimate the amount you should set aside from your grant money to conduct the two required evaluations.

	Work Being Done by Facilitator	Typical Components *The evaluation process follows the same methodologies regardless of platform.*	Approx. Costs	Comments

1	Create usability evaluation plan and goals for the evaluation	• Skilled usability evaluation facilitator reviews your project, meets with you, and creates Evaluation Plan
		  • Identify major activities
		  • Create a timeline for evaluation, design, and reevaluation]
		  • Identify associated costs
		  • Determine major deliverables (such as evaluation reports, design recommendations, fixit lists, presentations)
		• Write usability goals for the evaluation
			$1600	Use a professional facilitator for both Evaluations. Using an outside facilitator gives you the additional benefit of a **fresh perspective** and unbiased interpretation of the results.

2	Recruit participants and compensate for their time (either you or an outside firm can recruit and schedule)	• Determine the right mix of end-users to have evaluate your product and reflect your audiences or user population
		• Develop a screening questionnaire
		• Work with a market research company or other professional recruiter that:
		  • Recruits appropriate users
		  • Compensates users for evaluation
		  • Can provide a central evaluation location, if you are not using the UCIRL
		  • Schedules and manages participant arrivals and acts as a point-of-contact for them
		  • Provides a matrix of the recruits and their demographic breakdown or answers to screener questions
			$625
			
			Recruiting and incentives:
			$2875
				Usually you will need the facilitator to write the screener but have the recruiting itself done by a professional recruiting company.
				Incentives paid to participants run from about $75 each for the general public to $200 each for clinicians.
				Recruiting fees typically range from $100 to $175 per participant.
				Estimate is based on 5 public + 5 clinicians.

3	Develop evaluation materials	• Write up major tasks/scenarios users will perform on the product • Draft and revise evaluation facilitators script • Create consent forms, note-taking materials, user profile questionnaires, post-evaluation questionnaires, etc.	$3000	
4	Conduct evaluation	• Trained facilitator conducts evaluation • Project note-takers observe and take notes on user actions, comments, etc. (optional) • Possible travel costs • (Add room rental costs if not using UCIRL) • (Add videotaping costs if not using UCIRL)	$3100	Estimate is based on 10 participants, 1-hour sessions. NCI encourages grantees to observe the evaluation in person at the UCIRL. If you attend the evaluation, include travel expenses in your Phase II budget. Recording is available. Travel: $400-500 airfare to the DC area, meals, transport, and 2 nights hotel is about $1200.

5	Develop usability evaluation report and present findings and recommendations	• Analyze notes, observations, tapes
		• Write Evaluation Report
		  • Summary of methods and participants
		  • Summary of major usability findings
		  • Summary of recommendations
		• Highlight of performance measures (efficiency, effectiveness, and satisfaction)
		• Present /discuss findings and recommendations
			$3200	

6	Prepare video clips *(OPTIONAL)*	• Create video highlights clips of key, illustrative examples from the evaluation. (optional)	[$500]	Useful when you cannot observe the sessions yourself.
		Estimate per evaluation **Travel for facilitator for evaluation at UCIRL** **Estimated Total for Both Evaluations**	**(2 x $14,400)** **+ $1,200** **$30,000**	Costs based on typical rates in 2007.

Cost estimates & activities for usability evaluations (8-10 participants each, 1-hour sessions).

III. Important for New and Intermediate Developers: About User-Centered Informatics Design

Examples of Applying UCD methods

Luckily, there are many techniques you can use to promote and improve usability in your product at different stages. We have mentioned several so far: interviews, contextual inquiry, and usability evaluation. The table on the next page identifies many of the UCD techniques and suggests when to use them in your process.

NCI recommends you take advantage of as many such techniques as are appropriate for your product and goals. Currently, we require you as an SBIR grantee to provide deliverables only for the required usability evaluations.

Below are two examples of products with usability problems and possible solutions. In each case, the developers needed to consider:

- How well does my product meet the users' needs as well as my intended business goals?
- When, where, how, and in what context will the product be used?
- What are the *human factors* such as learned expectations from other software, reading ability, and motor control?
- What are the environmental factors such as distractions or the political and social issues?

All can affect how well your product will succeed at what you and your users want it to do.

Example 1:
A website contains high-quality information about breast cancer. The site's creators intended it for the general public to use to learn about the most recent prevention techniques. However, when people learn of the website's links in magazine articles and go to the website, they cannot find the information about prevention. The topics are organized using terms that made sense to the health researchers, such as "morbidity rates," but most people in the general public don't scan for these technical terms.

Solution: *If you were designing the site, you might interview end-users to get an idea of the terms they are using and of what types of information they most want to find. You could then merge this information with your own goals for the site as you prepare for design. Another UCD technique for understanding how people think about information and terminology have potential site users categorize and label the site contents (called an "affinity card sort"). You would also need to consider the context: how will you handle references and links from unexpected places (such as Oprah's magazine website).*

Once you had a working prototype, you could conduct a usability evaluation to see how easily users find specific pieces of information. As part of a larger issue, you could also consider people's emotional satisfaction with the site—an emphasis on terms like "morbidity," if understood, could create a negative impression that might make people want to leave or not return to the site.

If you are at this stage	You will probably want to…	User-Centered Design Activities You Might Use
Planning	• Evaluate acceptance of your product idea and its usefulness • Benchmark the product (if it exists already) • Benchmark the competition	Interviews Focus groups or discussion groups Metrics-oriented usability evaluation of existing or competing product: • Measure task times, error rates, and subjective impression of an existing product or process
User Analysis	• Discover users' mental model(s) (how they think about the topic, what assumptions they make, how they understand the workflow) • Discover users' pain points (what's missing or most important to them to solve) • Evaluate early concept sketches	Interviews with users Design- or Metrics-oriented usability evaluation • Ask users to explain how they think the sketches or paper prototypes work, and what they think each element means • Ask users to perform a typical task with a prototype or existing version, letting them choose the task Contextual Inquiry (similar to field study) • Observe users in the environment(s) where you expect them to use your product
Early Design	• Evaluate UI concept • Evaluate UI navigation • Evaluate screen layout • Evaluate terminology • Evaluate key workflows • Evaluate key screens	Design-oriented evaluation • Ask users to perform key tasks • Ask users to locate key information and see if they understand it as written • Ask users to navigate to screens within the prototype • Ask users to find and use features of a device • Ask users to explain the elements of a prototype screen
Late Design and Specification	• Evaluate specific workflows • Evaluate specific screens • Evaluate user assistance strategy	Design-oriented evaluation • Ask users to perform specific tasks of interest
Build	• Fine-tune specific workflows and language • Fine-tune specific screens or controls • Compare usability of new version with benchmarks	Design-oriented or metrics-oriented evaluation • Ask users to perform tasks that require live screens and/or a database • Measure task times, error rates, and subjective impression
Release	• Compare usability of new versions with benchmarks • Benchmark current release	Metrics-oriented evaluation • Measure task times, error rates, and subjective impression

A variety of UCD methods can be applied throughout the design and development process.

Example 2:
A handheld portion-calculator for obese patients is designed to be taken with them everywhere during the first two weeks of their diet plan. Patients like the idea, but they leave the device at home because it does not have a "silent mode" and announces their meal choices out loud. (There is a way to turn off the announcement, but this feature is hard to find.) Also, many of the devices break; as it turns out, patient like to leave them in the kitchen, where they often get wet.

Solution: If you were designing this technology aid, you could begin your design by interviewing several likely patients and observing them in context, in their homes and throughout their day (referred to as conducting a ***contextual inquiry)****. You would then have a much better understanding of what characteristics your device should provide in order to fit patients' needs for privacy and protecting self-esteem. You would learn ways in which they would be likely to use the device, where they would take it, how they would carry it, etc. Your product design could then address those needs. Once you had a prototype, you could usability evaluation the device to see if the patients could figure out how to use it and whether it would survive the environments it would be in.*

These examples help show why NCI wants grantees to make sure their products are usable as well as being a "great idea". Your great idea for preventing, treating, or surviving cancer might fail because it is difficult to use, time-consuming or unpleasant for its audience to use (even if other people can use it just fine). The portion-control calculator might have helped the obese patients control their weight if the product team had invested in ensuring usability. Instead, the team wasted valuable time and money in producing a product that failed for reasons completely irrelevant to whether it was a good idea.

Apply UCD Methods Early and Often

A common misperception is that usability evaluation and other usability-improvement techniques can only be performed on working designs, late in the design or production process. This can't be further from the truth. The earlier you involve users—and design your product or system accordingly—the easier and cheaper issues are to fix.

An example of early UCD would be to run a quick evaluation on a paper or cardboard version of your initial design ideas, change the design to solve any problems uncovered early on, build your next design prototype, and evaluate again. Some interactive aspects of a product, such as the speed of a device's feedback or the effect of frequent errors, cannot be evaluated without a working prototype, but most design elements can be.

Because you can benefit by involving users frequently, you also should take advantage of the *iterative* nature of the UCD process. Designing in several iterations allows you to do upfront research into the users' environment, goals, and needs; make a few iterations of low-cost passes at your design that you usability evaluation; then create the more expensive final design that you can evaluate with a larger group, for detailed aspects of the design, or as a summation of whether you have met your usability goals.

For example:

> *If you are creating a nutrition website, a UCD expert might start early on with user interviews, and visits to usage locations (e.g., homes, offices, libraries, examination rooms), and begin drafting user profiles to categorize and characterize the different types of users you expect to have. Then you could develop early designs and run an early, design-oriented usability evaluation with users from the different groups: have the facilitator show your early screen sketches to users, ask them what they think will happen when they click on items on each screen, listen for terms they use and terms that confuse them, etc. Information like this shows how the users think about the site and about nutrition and what assumptions they make (their mental model of how the site works).*
>
> *An evaluation facilitator can do this evaluation quickly and informally with a few users and, if necessary, repeat it a few times to make sure you are heading in the right direction. A facilitator might also perform a card sort to identify how to categorize information and organize the site. Then, you could take what you learn from these evaluations and start coding the site. At a later point in the design, you might run a design-oriented or metrics-oriented evaluation to tell you if the redesign solved the problems and if you had achieved your usability goals.*

Small Numbers Can Yield In-Depth Information

User-centered design techniques usually point the way for design and improvement. For this reason, you do not need to evaluate with large enough numbers of people to provide statistically valid results. That is not the purpose of conducting these evaluations. Instead, they provide in-depth, rich data from a small number of people.

You will use UCD to help you hone your design to eliminate most issues relating to the user interface, layout, language, controls, and users' characteristics and context of use. Clearing these issues improves your chances at success in later, "big N" statistical studies and impact studies that will be analyzed by medical review boards and other critics.

IV. For All Developers: Determining User Profiles and Evaluation Type

The User-Centered Design process includes several specific tools and methods for ensuring a product achieves the goals you and your users want it to. *Usability evaluation* is one of the established UCD techniques for assessing how usable a product or design is.

The evaluation is performed as part of an iterative design process: You create an initial design or mock-up, evaluate it, amend your design based on the findings, reevaluate it, and continue if necessary until you produce a final, usable design. In usability evaluations, a skilled facilitator asks real users to complete representative tasks using the product.

During the evaluation, the facilitator and one or two observers watch the users, called *participants,* perform these tasks, noting which aspects of the product cause confusion and which aspects work well. Example tasks might include, "Calculate your patient's risk of developing breast cancer," using a PDA application, or "Determine how much calcium is in one serving of broccoli" using a nutrition website aimed at caregivers.

Determining the User Profiles for Evaluation: Who Will Use Your Product?

Before you run a usability evaluation, you should think of the different groups of users who you eventually want to use your finished product. You will want to evaluate your design and prototypes with representatives of all the important subgroups. This is referred to as creating *profiles* of users.

Think of subgroups as well as main groups, including people who manage or oversee the end-users or users with differing experience levels. For instance: if your product is designed for nurses, you will want to consider evaluating with nurses in large hospitals as well as those in small facilities, as they may have different nursing roles or experience levels with technology. You then might consider "nurses' aides" and "administrative staff' (who print out the records), and even doctors who might need to check the data for reliability.

Once you determine all the different user profiles, you should try to recruit evaluation participants who roughly match the breakdown of your user subgroups. That way, you will not omit an important group when designing your product.

Choosing the Type of Evaluation: What Do You Need to Learn?

A usability evaluation can result in information to improve the product's design or in a set of objective measurements to compare your design's efficiency, effectiveness, and satisfaction rate to preset goals.

There are two basic types of usability evaluation:

- design-oriented (called "formative testing" in the field of usability engineering)
- metrics-oriented (called "summative testing" in the field of usability engineering)

Both types can be part of an iterative design process. Each type of evaluation has different protocols because of the different goals for evaluation. Usually, design-oriented evaluations are intended to inform design, while metrics-oriented evaluations check an established or near-final design for an acceptable level of usability.

Depending on your needs, you can conduct usability evaluation at different stages. Design-oriented evaluations done early and throughout the design process are often the most helpful for yielding design insights, while metrics-oriented evaluations at the beginning or end of the process can document a product's starting usability or provide a benchmark for later releases.

A caution, however: Conducting a design-oriented usability evaluation a few weeks before final release can be a formula for frustration. Conduct the evaluation earlier in the process, when it is easiest to fix problems and before unnecessary or misdirected work is done. It is costly to fix them later. Avoid learning of a critical problem when you have already done the bulk of the work.

Typically, you will want at least one round of design-oriented evaluation, upon which you will assess your goals, redesign, and re-evaluate.

Design-Oriented Evaluations

Design–oriented, diagnostic usability evaluations focus on improving a product's user interface by probing into what problems exist and why.

With design-oriented evaluations, the product team typically produces an early design or prototype and then asks users to "test drive" it (or read it, if a document) by performing critical tasks.

- The team considers design questions and task-related user goals for the product.
- The users are asked to "talk aloud" while performing the tasks. This helps the facilitator and observer understand the user's thought processes, assumptions, expectations, and any errors.
- The facilitator asks probing questions for clarification.
- The team then takes the evaluation results and redesigns aspects of the user interface.

A subsequent usability evaluation shows whether the changes were effective. This cycle of design-evaluation-redesign produces a clearly usable product.

Setting Goals for Design-Oriented Evaluations

While you might not set specific, testable goals for design-oriented evaluations, you would need to think about some of the design questions you would like to answer. Often, you or your skilled usability practitioner will have some idea of areas you think might pose problems, or you will have open questions as to how best to design certain aspects of your product.

Examples of design questions you might answer for design-oriented evaluations include:

- Will less experienced users have trouble finding the drug interaction codes list?
- Do the participants from the "members of the public" user group feel comfortable entering their health statistics?
- Do nurses notice the text box of guidelines at the beginning of the document?
- Can nurses used to using Product A figure out how to use our product to add a patient to their roster? Does the order of data entry make sense?
- Will new users be able to find and send the status information?

How many design-evaluation-redesign cycles are appropriate? The answer depends on your schedule and quality priorities. Many projects define a set number of cycles so that they can

meet a deadline for release, while others establish key usability goals and exit the cycle only when they have achieved those goals.

Early versions of a product's user interface may be simple paper sketches (low-fidelity prototypes), while later prototypes in the cycle may be non-functional or even functional prototypes (high-fidelity prototypes). Professional usability evaluation facilitators can perform evaluations on both low-fidelity and high-fidelity prototypes.

Metrics-Oriented Evaluations

Metrics-oriented evaluations focus on objectively measuring a product's usability. Typical measurements include the amount of time needed to complete critical tasks and the number of errors participants make for each task.

For a metrics-oriented evaluation, the product team would likely work with a prototype that was close to fully functioning. To get accurate completion times, etc., you must have a high-functioning prototype (at least for the areas you want to evaluate).

- The team sets testable, quantifiable usability goals for their product.
- The facilitator runs the evaluation without asking probing questions or interrupting the participant.
- The facilitator uses a clock or software logging to collect time data.
- Findings are counted, averaged, and assessed to see if the goals had been met.
- If not, the team can see where the numbers indicate problems and focus redesign work on this area. If there is no time left for redesign at this point, the team can use the information to plan their next release or next year's publication.

Setting Goals for Metrics-Oriented Evaluations

To set goals for metrics-oriented evaluations, start by thinking of reasonable or competitive standards. Analyze the tasks and consider your user groups' needs, expectations, and competing products. For example, consider what users think an acceptable amount of time is for task completion. How long does it take with other, similar products? How accurately does the user complete the task, even if done quickly? Is there a reason the task must be done within a certain time?

A sample usability goal for a website intended to connect patients with clinical trials might be, "Users must be able to find a trial for which they qualify in less than five minutes and with no critical errors." Another might be, "Users of the new version should be able to complete the signup form accurately at least 20% faster than in the current version."

Usability goals for metrics-oriented evaluations should be explicitly testable. For example:

- The mean time to complete a search should be 1 minute or less.
- The mean error rate for query syntax should be less than 1 error per attempt.
- All users must be able to complete a search in 5 minutes or less.
- All users must be able to complete a search with:
    - No critical errors (user unable to complete task).
    - A mean of less than 2 minor errors (navigation or data entry error from which the user recovers and completes the task).

A metrics-oriented usability evaluation allows the product team to measure whether users are achieving the stated usability goals. The results of such an evaluation either provide clear

documentation of a usable interface or they allow the product team to concentrate their efforts only on those areas causing problems.

Another common use for metrics-oriented usability evaluation is to establish a usability baseline for later comparison – either against a revised version of the same product or against a competing product.

V. Scoring User-Centered Informatics Evaluations: Ranking the Issues

A usability evaluation will reveal usability problems of different kinds. Some of the issues might be critical—they prevent people from using your product, cause people to make serious errors, or confound their understanding of the product. Others might cause only minor confusion but be numerous and easy to fix.

NCI **does not apply a standardized scoring system** to the results of usability evaluations or officially rate your product against other products. However, you will be expected to fix all critical and high issues, most moderate issues, and as many low-impact issues as possible. Keep in mind that a "low" issue in one product might be a "high" issue in another, depending on the impact it has on behavior, comprehension, and satisfaction.

While there is no universal rating system for usability issues and how to decide which ones to fix, many professionals in the User-Centered Design community follow a prioritized scoring system such as the one below.

Ranking	Type of Usability Issue	Examples
1 Critical "Showstopper"	Critical problems or situations that prevent use, cause harm, or offend users. • Causes major, time-consuming errors • Causes errors that can't be recovered from or that people don't realize they've made. • Crashes the system or stops something else in the user's environment from working • Prevents people from using the product • Causes harm of some kind • Is missing a critical feature • Users "give up" using the product	• Users can't tell they are supposed to save their inputs, so they lose their work. • The brochure text misleads the reader or the reader can't locate critical information. • Starting the software shuts down the user's PDA. • Legal issues.
2 High	Serious problems that impair use of the product but do not cause damage or prevent use. • Causes significant errors that the user notices and solves. • Fails to prevent the user from making a mistake • Fails to give feedback that an important action has been taken. • Causes significant anger, offence, or mistrust of the product. • Is missing important features or information users need.	• The product does not show whether it is turned on or off. • People can find the information they want, but it takes so long they are frustrated and can't find it again. • People worry the product will share their personal data.

3 Moderate	Important, but not critical problem. Does not prevent use or cause harm, and can be worked around. Compares poorly with alternative products. • Causes moderate confusion. • Causes moderate errors. • Causes minor errors that are not noticed and fixed. • Includes misleading (but not harmful) information. • Misuses standard controls or terminology. • Is highly inefficient but can be used.	• People can find the information on your website, but only after looking for a long time. • Labels are missing but are correctly "guessed at". • Error messages are hard to understand.
4 Low	Small problems and inconsistencies that cause uncertainty. • Causes minor or temporary confusion • Typos (that don't mislead) • Aesthetic, alignment, and shape issues.	• Misspellings and poor grammar. • Inconsistent or repeated minor information. • People don't know what page they're on.

VI. Contact Information

For more information or to request a user-centered design evaluation, contact the UCIRL consultant. Copy the NCI SBIR Program Director on all e-mail correspondence.

NCI SBIR Program Director, Connie Dresser

- (301) 435-2846
- cd34b@nih.gov

UCIRL Consultant, Christy Mylks:

- (301) 451-9969
- mylksc@mail.nih.gov

UCIRL General Contact Information

- (301) 451-4687
- 61164thflrlab@mail.nih.gov

When requesting an evaluation, please review and fill out the NCI User-Centered Informatics Evaluation Request form (shown in Appendix A). The Consultant can help you more effectively once you have emailed the request form.

VII. Appendix A: Request for an Evaluation

Before requesting an evaluation, please fill out the following form and fax or email only these form pages to the UCIRL Consultant at fax/301-480-3441 or mylksc@mail.nih.gov. Fill out as much as possible. If you don't understand an item, enter a question mark. The Consultant will need the information below to assist you.

Basic Evaluation Info

Grantee/Contractor group or person requesting evaluation	
Grant or Contract project name	
Name of product being evaluated	
Type of product (website, PDA, brochure, etc.)	
Is there any existing prototype?	
Main point-of-contact names, phones, emails	
Important deadlines for scheduling	
Other key information	

Evaluation Staffing

Role	Number of People	Need help finding a consultant?
Evaluation Facilitator (consultant) *(Most grantees need help identifying a skilled facilitator.)*	1	Yes No If no, please provide name and contact info for your facilitator: Name: Phone/s: Email:
Other (e.g., specialized equipment support staff)- Identify role:		Yes No
If members of your project team will be coming to NCI to observe the evaluation, please identify the number of people (up to 10). *(Note that travel expenses are not included in the $23,000 evaluation estimate, and travel costs and planning are your responsibility outside of NCI funding.)*	Will you be attending? Yes No Number attending:	n/a
Do you want to provide remote observation capability? (*to view the evaluation via the Internet)*	Number observing remotely:	n/a

Evaluation Goals
(Goals for what the results of the evaluation should tell you)

	Evaluation Goals
State the goals of the evaluation in 1 or 2 sentences. Are there any key questions you have or any established metrics to meet?	
Should the data gathered be qualitative (design) or quantitative (metrics)? *(If you are not sure, the UCIRL can help you with this.)*	

Product Goals
(Your goals or intentions for the product)

	Product Goals
List your goals for what the product is supposed to accomplish (what you want people to do with it, what impact it should have, how you want them to use it)	1. 2. 3.

Audiences/Users and Their Goals
(The users' expected goals or reasons for using the product)

Audience or User Groups	Audience/User Goals
Identify and describe the different user or audience groups, as many as appropriate *(Example: "Nurse practitioners in rural hospitals.")*	**Below, list your users' or audiences' goals for the product. Consider their viewpoint rather than your own or your project's viewpoint. Why would they want to use this product? What are they trying to accomplish, solve, or learn, from their perspective?**
Primary:	**Primary Audience goals:**
1.	goals:
2.	goals:
3.	goals:
Secondary:	**Secondary audience goals:**
1.	Goals:
2.	Goals:

Recruiting Participants for the Evaluation

User or Audience Groups	# of Users Per Group	Need Recruiting?	Anticipate difficulty reaching or scheduling them?	Targeting certain geographic locations? (e.g., only in Florida or only urban)

Evaluation Prototype

	Description
Please describe the prototype, if applicable. What is it? What medium is it in?	
Where or how can we view the product? For example, for websites, provide the URL ("http://www…").	
Do user accounts, passwords, or other security measures need to be created? Please describe.	
Does the prototype need to be reset to a starting condition after each evaluation?	
Is any special software or attachment needed to operate the prototype?	

Recording and Observation

Needs	Yes/No
Video recording of user's screen (screen capture) and/or face or physical actions. (VHS, DVD, or Mini DV cassette)	(describe need)
Video editing and production of highlights tapes. (DVD or Mini DV) *(sometimes used for persuasion- in order to show others or illustrate a point)*	
Other:	

Evaluation Report

Strategy	
Report (required)	(Required)
Sketches of redesign recommendations, if applicable	Yes No
In-person presentation of key findings (recommended)	Yes No
Working Meeting between your team and the evaluator (recommended for design-oriented evaluations especially)	Yes No

VIII. Appendix B: Additional User-Centered Design Resources

You can find additional resources about usability evaluation and user-centered design at the sites listed below:

Evaluation Information

Reference these items for information about how to plan and conduct a usability evaluation:

- www.usability.gov/basics: An easy-to-read resource based on input from experts in the field. A division of the U.S. Department of Health and Human Services (HHS) collected and synthesized usability-related resources and information on Usability.gov. Beginners should start with this introduction.
- http://www.usability.gov/refine/learnusa.html: Specifically, usability.gov's definition and guidelines for how to conduct usability evaluations.
- www.stcsig.org/usability/topics/testing_techniques.html: The Society for Technical Communication's collection of usability evaluation guidelines and techniques.

Books:

- **Don't Make Me Think,** by Krug, S. A slim, easy-to-read introduction to basic usability testing.
- **A Practical Guide to Usability Testing,** Dumas, J. and Redish, J. Revised Edition, Intellect, 1999. ISBN: 1-84150-020-8. This classic book provides extensive and reliable guidance on all aspects of conducting usability evaluations, from creating user profiles to conducting the evaluation and analyzing the results.

User Interface Design Guidelines (Heuristics)

Reference these items for information about how to plan and conduct a usability evaluation:

- www.usability.gov/guidelines: Usability.gov's evidence-based guidelines for good web interface design.
- www.useit.com/papers/heuristic/heuristic_list.html: Expert Jakob Nielsen's list of 10 user interface design principles.
- www.cognetics.com/services/design_services/ucd_docs/heuristic_guidelines.html: Cognetics Corporation's list of user interface design principles.
- www.stcsig.org/usability/topics/heuristic.html: The Society for Technical Communication's collection of information about heuristic reviews.

User-Centered Design Organizations

- **Usability Professionals Association** (www.upassoc.org): A good resource for finding consultants to facilitate evaluations, and a resource of reference information.
- **Society for Technical Communication**—Usability Special Interest Group (www.stcsig.org/usability) : Well-constructed lists of resources.
- **Special Interest Group in Computer-Human Interaction** (www.sigchi.org): A good place to find research articles; also has CHI Jobs and CHI Consultants email lists to which you can post a request for consultants.